Physics

RECENT progress in physics has been marked by the performance of good experiments rather than the emergence of fundamental unifying ideas. Anderson and his colleagues at the California Institute of Technology, and Steinberger and his group at the University of California, have confirmed the earlier observations of Rochester and Butler, and there is now good evidence for an electrically neutral meson. Also, groups of investigators at the universities of Rochester and Minnesota have established the important role of heavy particles in cosmic ray events. The pioneering exploration of the nucleus just prior to and following the war is giving place to the careful quantitative experimentation necessary for the formulation of an adequate theory of nuclear phenomena. A start, but only a start, has been made on the careful measurement of the energetics of nuclear processes. The current theories of nuclei are heuristic and phenomenological, and the firm establishment of a general theory must apparently await the accumulation of more reliable and quantitative data.

War-born techniques have contributed to some of the most interesting recent experimental advances in atomic physics. Facility in the generation and measurement of radiation in the microwave region in the hands of many groups throughout the country is leading to the precise determination of the small energy intervals characterizing hyperfine structure in atomic and molecular spectra. This new technique is comparable in power to the development of the ruled grating by Rowland, and it leads directly to the precise measurement of magnetic dipole and electric quadrupole moments of nuclei. Precision measurements of the precessional frequency of the proton moment in known magnetic fields by Hipple and his colleagues at the National Bureau of Standards have not only yielded an absolute value of the ratio of the magnetic moment to the angular momentum of this elementary nuclear particle, but have provided a simple and valuable general technique for determining magnetic field strengths in terms of frequencies. Extensions of such experiments to the measurement of characteristic rotational frequencies of ions in known magnetic fields by Hipple and also by Goudsmit and Smith at the Brookhaven National Laboratory promise to yield considerably more precise values than we have at present for atomic masses.

Finally, these techniques of precision frequency measurement in the microwave region by Hanson and Bolt at Stanford have led to a more accurate measurement of the velocity of light than we possessed heretofore. This is a fundamental parameter in atomic theory and an essential copulative datum between high-energy radiation, which is measured fundamentally in terms of a length, and low-energy radiation measured in terms of a frequency or time. It is interesting to note that the value obtained for the velocity of light by Michelson and his assistants over two decades ago was recently called into question by certain geodetic measurements of Aslakson, and the program started by Hanson for measuring the resonant frequency of a cavity with a precisely known dimension has corrected the value of this quantity, as well as extending the precision of the measurement.

The applications of physical techniques have stimulated other fields of science. The most striking recent instance is without doubt the use of the techniques of radioactivity in conjunction with artificially prepared radioactive substances in chemistry, biology, medicine, and archaeology. Tracer techniques furnish a method of attack upon the problems of organic materials and the processes of living organisms. These problems are of such magnitude and complexity as to appall the mere physicist, and he can but proffer this method in all humility to those courageous investigators who are undertaking to unravel the mysteries of a living cell.

G. P. HARNWELL

Randal Morgan Laboratory of Physics
University of Pennsylvania

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